PSYCHE.

A PROBLEM IN DISTRIBUTION.

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In a systematic* paper on North American Mallophaga, published in 1896, I briefly outlined a "problem in distribution" (pp. 48–57 of the paper referred to) which seemed to me at that time a very suggestive problem, indeed, but which had a slightly uncertain note in its assumption of certain foundation facts. These assumed conditions had, truly, all the seeming of facts, but there failed a possible absolute verification of them. A recent trip to Europe has given me opportunity to examine (by the kindness of Prof. Otto Taschenberg of the University of Halle) a sufficient number of type and authentically determined specimens of European Mallophaga to supply the needed verification of my earlier assumptions, and to discover further new and equally interesting incidents of the problem.

The problem, summarily stated, is this: The species of the Mallophaga (which are wingless, free-living, external parasites on birds and mammals) are, in a majority of cases, peculiar each to some one host species. But the instances are many in which this condition of distribution does not obtain, but where a single parasite species is common to a few, or to even many, host species. How does this latter condition come to exist?

As the Mallophaga are wingless their power of migration from bird to bird is evidently limited. They run strongly and quickly, but they can live for only a comparatively short time off the body of the warm-blooded host, or on its cold dead body. After a bird is shot the Mallophaga on it die in from two hours to three or four days; in infrequent instances I have found them alive on the drying skin of the host at the end of a week or ten days. Very rarely, indeed, have I found Mallophaga under natural conditions off of the body of the host. Accounts have been given of finding "chicken lice" on the roosts in chicken houses, a quite possible occurrence. But even in such a likely place as an ocean rock from which I had just frightened hundreds of pelicans, comorants and gulls have I looked vainly for Mallophaga which might be wandering from host to host.

* New Mallophaga I (Contributions to Biology from the Hopkins Seaside Laboratory, (VI 1896.

Wherever actual contact occurs between the bodies of the hosts, however, migration can and evidently does take place. In this way is the parasite species perpetuated on its normal host species; the parasites can migrate from male to female, and vice versa, during copulation, and from parents to young in the nesting season. But instances of contact among other individuals of the same host species and even among individuals of different host species are not only possible but in the case of certain birds are probably frequent. Wherever such contact occurs no further explanation of the occurrence of single parasite species common to two or more host species is necessary. There is also a possible explanation of possible rare cases of commonness of parasite species to two or more host species whose individuals apparently never come in contact. Sharp* has recorded a case in which a Hippoboscid (winged Dipterous parasite of birds) which was captured while flying "was found to have some Mallophaga attached to it." Such instances must be rare.

It will be of interest now to note the various kinds of cases (for the cases are fairly amenable to classifying) in which a parasite species is common to two or more host species. I have taken *Docophorus lari* from thirteen species of gulls (twelve species of Larus and one of Rissa), and *Nirmus lineolatus* from nine species of gulls (all Larus). The gulls are gregarious in habit, roosting together in great numbers on ocean rocks. Undoubtedly there is frequent absolute contact of the bodies of individuals of various species, giving opportunity for actual migration. But together with the gulls on the ocean rocks sit other maritime birds; for example, on Scotland's famous Bass Rock *Sula bassana* (a gannet), *Alca troile* (an auk), and *Rissa tridactyla* (a gull) breed socially together (see the striking wall-case of Bass Rock birds in the Natural History Museum, Kensington, London). On the "bird rocks" off Monterey, California, I have found cormorants, pelicans and gulls roosting together, and have found *Lipeurus toxoceras*, a long known parasite of the cormorants, on a pelican (*Pelecanus californicus*), as well as on the cormorants (*Phalacrocorax dilophus albociliatus*). Actual migration of the parasites from the captured prey to the raptorial capturer may evidently take place; I have found a *Physostomum* (genus normally limited to passerine birds) on a sparrow hawk. It is conceivable that among birds with whom hybridization is not infrequent a parasite species may become common to several hosts. Thus the hybridizing which is notorious among allied duck species may help account for the fact that *Docophorus icterodes* is common to many duck species (I have taken it from nine) and that *Trinoton luridum* is similarly common to many hosts (I have taken it also on nine duck species).

* Sharp, D., Proceedings entomological society of London 1890, p. xxx.

But the commonness of a parasite species to several host species occurs in cases where it seems impossible to assume an actual migration. The hawks have two or three parasites, as *Docophorus platystomus*, which are common to several of them: *Docophorus cursor* is common to several owl species, *Docophorus excisus* to several swallows, *Docophorus californiensis* to several woodpeckers, and *Docophorus communis* (with its so-called varieties) to a great many passerine birds. The other genera of Mallophaga present many similar cases. Now in all of the cases mentioned, and it is true of practically all of them unmentioned, it will be noted that the common hosts are closely allied forms, *i. e.*, different species of a single genus, or, and not infrequently, different but allied genera. Only in the case of *Docophorus communis* do we have a parasite's range extending over family limits, the hosts of this form representing several passerine families.

While actual migration in the just-mentioned cases is *almost* an impossible condition, there are other cases to which I shall now refer in which the possibility of actual migration is positively precluded. These cases are those in which a parasite species is common to both American and European hosts of different species and of habits and geographical range which absolutely preclude the possibility of the migration of the parasites from one host species to the other. A few details as to these cases should be of interest. Two hundred and sixty-two* species of Mallophaga have been taken from birds of North America. Of these 262 species, 157 are new species while the remaining 105 species are assumed to be specifically identical with Mallophaga originally described from European (or Asiatic) birds. In a dozen or more cases the American forms are called varieties of the foreign species. The determinations of the American specimens, referred to European species, were based on the descriptions and figures of the European authors Nitzsch, Giebel, Denny, Piaget, Taschenberg, et al. In the case of Piaget and Taschenberg, especially, these descriptions are detailed and excellent, and the figures good. There existed, however, a doubt in these determinations. As already mentioned, I have recently had opportunity to examine many European specimens in the collections of the University of Halle, and to compare with them American specimens taken with me for the purpose of this study. This comparison leaves no question as to the specific identity of American and European specimens taken from different host species. I could not make this comparison for all of the 105 species presumably identical, but could do it for

* The records of the occurrence of these species are included in Professor Osborn's papers, notably his "Insects Affecting Domestic Animals," Bull. no. 5. n.s., Div. of Ent., U. S. Dep't. Agric., 1896, and in my New Mallophaga, I. (1896), New Mallophaga, II, (1896), and New Mallophaga, III, (now printing). A very few records are included in the works of European authors. The number given, 262, is subject to correction, due to a few instances of duplication in Professor Osborn's and my papers.

many of them, and in all of the cases studied the identity is apparent.*

To consider now the problem of how this condition comes to exist we may first refer to and put out of the way the few cases of the common occurrence of a bird species on the two continents, as in the case of imported species (domestic fowl, song-birds, the English Sparrow), or in the case of species of circumpolar range. We may take into account, also, the remote possibility of the meeting on mid-ocean islands of American and European maritime birds of different species. Eliminating these few explicable instances of the commonness of parasite to the two continents, we have left the great bulk of cases to explain in some way which does not presuppose an actual migration from European to American host.

Now it is to be noted that the several host species to which a parasite species is common are almost always closely allied forms, that is, species of the same genus or representatives of two closely allied genera. For examples, *Docophorus pertusus* described by Nitzsch from *Fulica atra*, the European coot, I have taken from *Fulica americana*, the American coot; *Docophorus latifrons* described by Nitzsch from *Cuculus canorus* I have taken from *Coccyzus californicus occidentalis*; *Nirmus fuscomarginatus* found in Europe on Podiceps I have found in America on Colymbus; *Nirmus piceus* from the European avocet, *Recurvirostra avocetta*, is found in America on the American avocet, *Recurvirostra americana*; *Lipeurus ferox*, recorded from two European species of *Diomedea* I have taken from *Diomedea albatrus* (California); *Lipeurus forficulatus* described by Nitzsch from *Pelecanus onocrotalus* I have taken from *Pelecanus erythrorhynchus* (Kansas) and *P. californicus* (California). And so on through the seventeen or eighteen other genera of Mallophaga. There are a few instances, it must be said, in which the relationship of hosts is not so close, the always conspicuous example of this condition being the occurrence of *Docophorus communis* through several families of passerine birds. But it may be said almost without qualification that where a parasite species found in Europe has also been found in America its American hosts are the American species representing the European genus, or belong to a genus very closely allied to the European one. On this fact I base my belief that the occurrence of a parasite species common to several hosts under circumstances which do not admit of the migration of the parasites from birds to bird is due to the persistence of the parasite species unchanged from the common ancestor of the two or more now distinct but closely allied bird species. With the spreading of the ancestral species, geographical races have arisen within the limits of the species which have with time and with isolation, caused by newly appearing

* Indeed, I have made new species out of one or two American forms which should evidently be referred to already known European species.

geographical barriers due to geologic or climatic changes, come to be distinct species — species often distinguished only by superficial differences in color and markings of plumage, etc. The parasites have remained practically unaffected by the conditions which have produced the differences among the birds; the temperature of the host's body, the feathers as food, all of the environment of the parasite is practically unchanged. The parasitic species thus remains unchanged, while the ancestral Larus or Anas species becomes differentiated into a dozen or score of specific forms, all with a common parasite. If this proposed solution of the problem may be accepted, it introduces a factor into problems of distribution, where parasites are concerned, which I do not recall having seen presented before.

NOTES ON NEW ENGLAND ACRIDIIDAE, IV,— ACRIDIINAE, I.

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The New England species of Acridiinae or spine-breasted locusts are readily recognized by the presence of a prominent spine or tubercle projecting from the prosternum between the bases of the anterior pair of legs. Sixteen species of this sub-family have been taken in New England; one of these, however, *Schistocerca americana*, being of purely adventitious occurrence. Those that form the fauna proper to the district fall into two groups: two species of Schistocerca, and thirteen species of Melanopli. The former genus is at present undergoing revision by Mr. Scudder; the latter group forms the subject of his monumental "Revision of the Melanopli" (Proc. U. S. Nat. Mus., vol. xx, pp. 1-421) to which the student is referred for a general discussion of the group, for systematic characters, and information concerning its extralimitally.

I have adopted here the sequence of genera and species given in that work, preceded by Schistocerca, as follows: Schistocerca (3 sp.), Hesperotettix (1 sp.), Podisma (1 sp.), Melanoplus (10 sp., in this order,— *atlanis*, *scudderi*, *mancus*, *fasciatus*, *femur-rubrum*, *extremus*, *minor*, *collinus*, *femoratus*, *punctulatus*), and finally, Paroxya (1 sp.). The student dealing with specimens from New England or the northeastern States alone, however, will find a different arrangement of his collection preferable, e. g., the following:— Schistocerca (3 sp.), Paroxya, Hesperotettix, and Podisma (each monotypic in New England), and finally Melanoplus, in this order: *mancus*, *scudderi*, *atlanis*, *femur-rubrum*, *extremus*, *fasciatus*, *minor*, *collinus*, *punc-*